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ON THE EPIBIOTIC AND PELAGIC
CHLOROPHYCEAE, PHAEOPHYCEAE,
AND RHODOPHYCEAE OF THE
WESTERN SARGASSO SEA

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This paper provides a taxonomic account of the epibiotic and pelagic Chlorophyceae, Phaeophyceae, and Rhodophyceae collected during six cruises to the Western Sargasso Sea and follows two previous studies by the author (Woelkerling, 1972; 1973) of non-planktonic algae from this region. Earlier published records (e.g. Collins, 1917; Conover & Sieburth, 1964; Farlow, 1914; Hentschell, 1921; Pratt, 1935; Winge, 1923) of green and red algae and of brown algae other than *Sargassum* from the Sargasso Sea are few and fragmentary, and, with one or two exceptions, they do not include identifications to species level.

Nearly 75 percent of the taxa encountered during this investigation have not been reported previously from the Sargasso Sea, and these new records raise the total known flora of the region to include 10 Chlorophyceae, 25 Phaeophyceae, and 33 Rhodophyceae. Epibiotic Bacillariophyceae (see Carpenter, 1970) and epibiotic Cyanophyceae (see Carpenter, 1972; Hentschell, 1921) are not treated in this paper.

Methods of sampling and processing are outlined elsewhere (Woelkerling, 1973); voucher material (with specimen numbers prefaced by WJW) has been retained in the author's personal collections, currently housed at WIS. Other herbarium abbreviations follow Lanjouw & Stafleu (1964).

Data provided for each taxon includes references to records of occurrence in adjacent regions and/or of general taxonomic value, the type locality and reported location of the type collection (in most cases, location of types has not been verified), known distribution based on published records, and collection data for all specimens examined. This information usually is followed by ecological and/or taxonomic notes. In cases where specific identification has not been possible due to fragmentary and/or very young or small plants, the available data has been summarized briefly at the generic level. The genus *Sargassum* presents special problems regarding species identification, and these are outlined in the discussion of that taxon.

Epibiotic taxa can be divided conveniently into two ecological groups, namely the permanent element and the invading element. The former includes all taxa epibiotic on *Sargassum fluitans* and/or *S. natans*, the two brown algae which comprise the vast bulk of Sargasso Sea vegetation, estimated by Parr (1939) to be in excess of 4×10^3 metric tons. These two species apparently are endemic to the Sargasso Sea. The invading element includes all other "macroscopic" taxa (*Ascophyllum*, *Fucus* and their associated epiphytes (Woelkerling, 1972), species of *Sargassum* other than *S. fluitans* and *S. natans*, etc.).

The permanent epibiotic element comprises both taxa which are normally of small size (less than 1 cm tall) and diminutive forms of taxa normally of larger stature. Species in both groups, however, frequently bear reproductive structures, in marked contrast to *Sargassum fluitans* and *S. natans* which never have been found with receptacles (see, however, Parr, 1939, page 49) and reproduce solely by fragmentation as far as is known.

Sincere thanks are due Mr. Gordon Volkmann of the Woods Hole Oceanographic Institution for making arrangements for the collection of samples in the Sargasso Sea and for making passage possible for the author on one of the cruises. Thanks are also due Dr. Elizabeth M. Gordon for examining collections of the Ceramiaceae.

DIVISION CHLOROPHYTA

CLASS CHLOROPHYCEAE

ORDER TETRASPORALES

Family Palmellaceae

Genus *Pseudotetraspora* Wille, 1906

Pseudotetraspora marina Wille 1906:20, Taf. 1, Figs. 32-36.

TYPE LOCALITY: Steinviksholm, Drontheimsfjord, Norway.

TYPE: not located.

DISTRIBUTION: apparently known only from the Sargasso Sea and Norway.

SPECIMENS EXAMINED: Sargasso Sea: 31°N-70°W, 5.vii.1970, *Volkmann* (WJW 2735); 32°09'N-64°58'W, 16.v.1970, *Woelkerling* (WJW 2670); 34°N-70°W, 30.vi.1970, *Volkmann* (WJW 2727), 6.vii.1970, *Volkmann* (WJW 2748); 35°54'N-70°30'W, 13.viii.1970, *Moore* (WJW 2901); 37°N-70°W, 12.v.1970, *Woelkerling* (WJW 2625); 37°30'N-70°W, 8.vii.1970, *Volkmann* (WJW 2708); 39°07'N-70°35'W, 16.viii.1970, *Moore* (WJW 2919, 2927); 39°30'N-71°W, 6.x.1970, *Volkmann* (WJW 2871).

The small, amorphous, gelatinous thalli have been found as epiphytes on *Sargassum natans*, *Sargassum* sp., and *Cladophora*.

Howe (1920) described a *Pseudotetraspora antillarum* from the Bahamas and separated it from *P. marina* on the basis of apparent differences in color, shape of the gelatinous mass, and cell size. These criteria require further consideration since the Sargasso Sea specimens could conveniently be placed in either taxon. Howe (1920), for example, lists cell diameters of 3-7 μm for *P. antillarum* while Wille (1906) gives cell diameter of 4-10 μm for *P. marina*. The Sargasso Sea plants have cell diameters of 3-14 μm . A critical comparison of the types and other collections of the two taxa may well show them to be conspecific.

ORDER CHAETOPHORALES
Family Chaetopeltidaceae

Genus *Diplochaete* Collins, 1901

Diplochaete solitaria Collins 1901:242. Chapman 1961:69, Fig. 73. Collins 1909:278, Fig. 99. Collins and Hervey 1917:38. Taylor 1960:53.

TYPE LOCALITY: Kingston, Jamaica.

TYPE: NY.

DISTRIBUTION: Bermuda, Jamaica, Sargasso Sea.

SPECIMENS EXAMINED: Sargasso Sea: 26°57'N-72°58'W, 26.iv.1970, Moore (WJW 2647, 2651); 28°N-70°W, 4.iii.1970, Volkmann (WJW 2435); 31°N-70°W, 5.vii.1970, Volkmann (WJW 2734); 32°09'N-64°58'W, 16.v.1970, Woelkerling (WJW 2664, 2668); 34°N-70°W, 30.vi.1970, Volkmann (WJW 2726, 2747); 35°54'N-70°30'W, 13.viii.1970, Moore (WJW 2900); 36°28'N-70°29'W, 15.viii.1970, Moore (WJW 2908); 37°N-70°W, 12.v.1970, Woelkerling (WJW 2618); 38°22'N-70°58'W, 12.x.1970, Volkmann (WJW 2891); 39°07'N-70°35'W, 16.viii.1970, Moore (WJW 2916); 39°30'N-71°W, 6.x.1970, Volkmann (WJW 2860, 2885).

This species appears to be a rather common component of the Sargasso Sea flora and has been found, sometimes in considerable numbers, on both *Sargassum fluitans* and *S. natans* as well as on a variety of red algae, *Cladophora* (Chlorophyta), and on hydroids.

Cells in the collections examined bear 1-4 setae that may be oriented in any direction relative to one another but generally are directed away from the substrate. As noted by Collins (1909) the freshwater taxa often referred to the genus *Polychaetophora* West and West (1903) may be congeneric with *Diplochaete* (see also Printz, 1964; G. S. West, 1908).

ORDER ULVALES
Family Ulvaceae

Genus *Enteromorpha* Link, 1820

Enteromorpha sp.

Two collections [31°N-69°29'W, 3.iii.1970, Volkmann (WJW 2369) and 34°N-70°W, 7.iii.1970, Volkmann (WJW 2397)] of *Sargassum fluitans* contained epiphytic plants

of *Enteromorpha* which appear similar to *E. flexuosa* (Wulfen ex Roth) J. Agardh (see Bliding, 1963, for a detailed account of *E. flexuosa*). Since the Sargasso Sea plants were all stunted (under 3 cm tall), however, specific determination could not be made with certainty.

Genus *Monostroma* Thuret, 1854

Monostroma pulchrum Farlow 1881:41. Collins 1909:211. Collins, Holden, and Setchell 1900:658. Taylor 1957:72. TYPE LOCALITY: Watch Hill, Connecticut.

TYPE: FH.

DISTRIBUTION: Connecticut to Nova Scotia, Sargasso Sea.

SPECIMENS EXAMINED: Sargasso Sea: 39°05'N-69°48'W, 10.v.1970, *Woelkerling* (WJW 2572); 39°11'N-69°24'W, 10.v.1970, *Woelkerling* (WJW 2550).

Two small plants of *Monostroma pulchrum* were found as epiphytes on *Fucus vesiculosus* L., which had apparently drifted out into the Northwestern fringes of the Sargasso Sea (see Woelkerling, 1972). Critical studies are needed to determine whether *M. pulchrum* is really specifically distinct from the more widely distributed and better known *M. oxyspermum* (Kuetzing) Doty (see Bliding, 1968, p. 585, under *Ulvaria oxysperma*).

Genus *Percursaria* Bory, 1823

Percursaria percursa (C. Agardh) Rosenvinge 1893:963. Bliding 1963:20, Figs. 5-6. Collins 1909:197. Kylin 1949:16, Fig. 9. Taylor 1957:61; 1960:54.

Enteromorpha percursa (C. Agardh) J. Agardh Chapman 1961:66, Fig. 70.

TYPE LOCALITY: Adriatic Sea.

TYPE: LD.

DISTRIBUTION: widely distributed.

SPECIMENS EXAMINED: Sargasso Sea: 34°N-70°W, 13.v.1970, *Woelkerling* (WJW 2612); 37°N-70°W, 12.v.1970, *Woelkerling* (WJW 2627).

In both cases the host plant was *Sargassum natans*. The main axes and laterals were pleuriseriate while the smaller laterals were uniseriate in the specimens examined.

Genus *Ulva* Linneaus, 1753**Ulva** sp.

One young plant [34°N-70°W, 7.iii.1970, *Volkmann* (WJW 2412)] of *Ulva* was found as an epiphyte on a fragment of the grass *Spartina*. Specific determination was not possible. The *Spartina* fragment apparently had drifted out from the U. S. coast.

ORDER CLADOPHORALES

Family Cladophoraceae

Genus *Cladophora* Kuetzing, 1843

As noted by Taylor (1960, p. 78), the genus *Cladophora* has been difficult to cope with in the American tropics and critical studies are badly needed. The recent monographs of Soderstrom (1963) and van den Hoek (1963), which will probably provide a basis for such studies, have been used in making specific determinations during this investigation.

Cladophora dalmatica Kuetzing 1843:263. van den Hoek 1963:186, Figs. 601-35.

C. oblitterata Soderstrom 1963:47, Figs. 38-54A.

TYPE LOCALITY: Split (Spalato), Yugoslavia.

TYPE: L (No. 937/281/406).

DISTRIBUTION: probably widespread.

SPECIMENS EXAMINED: Sargasso Sea: 26°57'N-72°58'W, 26.iv.1970, *Moore* (WJW 2646); 31°N-69°29'W, 3.iii.1970, *Volkmann* (WJW 2374); 34°N-70°W, 10.i.1970, *Volkmann* (WJW 2205), 13.v.1970, *Woelkerling* (WJW 2614); 37°N-70°W, 12.v.1970, *Woelkerling* (WJW 2620); 37°30'N-70°W, 8.vii.1970, *Volkmann* (WJW 2704); 38°22'N-70°58'W, 12.x.1970, *Volkmann* (WJW 2886); 39°07'N-70°35'W, 16.viii.1970, *Moore* (WJW 2918).

Specimens up to 3 cm tall have been found both on *Sargassum fluitans* and *S. natans*. In all cases the apical cells were under 20 μ m in diameter and the branch systems showed a distinct acropetal organization.

Cladophora laetevirens (Dillwyn) Kuetzing 1843:267. van den Hoek 1963:128, Figs. 409-429, 433, 440.

TYPE LOCALITY: England.

NEOTYPE: BM (H4351/60/6); see van den Hoek 1963; p. 128.

DISTRIBUTION: probably widespread.

SPECIMEN EXAMINED: Sargasso Sea: 31°N-69°29'W, 3.iii.1970, *Volkmann* (WJW 2359).

The only specimen (about 2.5 cm tall) encountered during this study occurred as an epiphyte on *Sargassum fluitans*.

Cladophora socialis Kuetzing 1849:416, 1854:15, pl. 71, Fig. 1. van den Hoek 1963:43, Figs. 79-91.

TYPE LOCALITY: Tahiti.

TYPE: L (937/253/440).

DISTRIBUTION: Europe, Tropical Oceania, Sargasso Sea.

SPECIMEN EXAMINED: Sargasso Sea: 26°57'N-72°58'W, 26.iv.1970, *Moore* (WJW 2650).

The plants, up to 2 cm tall, occurred as epiphytes on *Sargassum natans*.

Genus *Spongomorpha* Kuetzing, 1843

Spongomorpha arcta (Dillwyn) Kuetzing 1849:417. Collins 1909:359. Taylor 1957:90, pl. 6, Figs. 5-6.

Cladophora arcta (Dillwyn) Kuetzing 1843:263. Collins, Holden and Setchell 1896:224; 1901:815.

TYPE LOCALITY: England.

TYPE: presumably in NMW.

DISTRIBUTION: colder waters of Europe and North America.

SPECIMENS EXAMINED: Sargasso Sea: 38°53'N-69°39'W, 10.v.1970, *Woelkerling* (WJW 2561, 2567); 39°05'N-69°48'W, 10.v.1970, *Woelkerling* (WJW 2571).

Specimens up to 2 cm tall were found attached to plants of *Ascophyllum nodosum* and *Fucus vesiculosus* which had drifted out to the Northwestern fringes of the Sargasso Sea (see Woelkerling 1972). *Spongomorpha arcta* is probably not a permanent component of the Sargasso Sea flora.

DIVISION CHROMOPHYTA

CLASS PHAEOPHYCEAE

ORDER ECTOCARPALES

Family Ectocarpaceae

Genus *Ectocarpus* Lyngbye, 1819

Ectocarpus elachistaeformis Heydrich 1892:470, pl. XXV, Fig. 14. Boergesen 1914:18, Fig. 11; 1920:435. Collins and Hervey 1917:70. Earle 1969:132, Fig. 28. Taylor 1928:107, pl. 14, Fig. 12; 1960:202, pl. 29, Fig. 9.

TYPE LOCALITY: New Guinea.

TYPE: probably destroyed.

DISTRIBUTION: Caribbean Islands, Gulf of Mexico, New Guinea, Sargasso Sea.

SPECIMENS EXAMINED: Sargasso Sea: 31°N-69°29'W, 3.iii.1970, *Volkman* (WJW 2382, 2384); 34°N-70°W, 10.i.1970, *Volkman* (WJW 2211).

Plants up to 5 mm tall occurred as epiphytes on *Sargassum natans* and on an unidentified *Sargassum* sp. Plurilocular organs are relatively abundant but are not as elongate-lanceolate as described by Boergesen (1914).

Genus *Feldmannia*, Hamel, 1939

Feldmannia irregularis (Kuetzing) Hamel 1931-1939:XVII, Fig. 61F. Cardinal 1964:54, Fig. 29. Kuckuck 1963:371, Fig. 6.

Ectocarpus irregularis Kuetzing. Boergesen 1926:25, Figs. 12-14. Chapman 1963:11. Rosenvinge et Lund 1941:50, Figs. 23-24. Sauvageau 1933:101, Figs. 24-27.

TYPE LOCALITY: Adriatic Sea.

TYPE: L.

DISTRIBUTION: northern Europe, Canary Islands, Sargasso Sea.

SPECIMENS EXAMINED: Sargasso Sea: 28°N-70°W, 4.iii.1970, *Volkman* (WJW 2431); 31°N-60°29'W, 3.iii.1970, *Volkman* (WJW 2366); 34°N-70°W, 7.iii.1970, *Volkman* (WJW 2413).

The Sargasso Sea specimens occur as epiphytes on *Sargassum fluitans* and *S. natans* and agree well with the account of *Feldmannia irregularis* given by Cardinal (1964). Plurilocular sporangia are common. Chapman (1963) records this taxon (as *Ectocarpus irregularis*) from Jamaica and, following Boergesen (1941), regards *E. rallsiae* (= *Giffordia rallsiae* (Vickers) Taylor (1960, p. 208), a widely distributed taxon in the American tropics) as conspecific. Earle (1969), however, maintains *G. rallsiae* as a distinct species. The precise relationships of *G. rallsiae* and *Feldmannia irregularis* thus remain uncertain and further critical studies of the type and other collections of the two taxa are needed.

Genus *Giffordia* Batters, 1893

Giffordia conifera (Boergesen) Taylor 1960:207. Earle 1969:135, Fig. 21.

Ectocarpus coniferus Boergesen 1914:8, Figs. 5, 6. Collins and Hervey 1917:69.

TYPE LOCALITY: U. S. Virgin Islands.

TYPE: C.

DISTRIBUTION: Sargasso Sea and tropical western Atlantic.

SPECIMENS EXAMINED: Sargasso Sea: 28°N-70°W, 4.iii.1970, *Volkmann* (WJW 2430); 34°N-70°W, 7.iii.1970, *Volkmann* (WJW 2416).

The Sargasso Sea specimens occur epiphytically on *Sargassum fluitans* and *S. natans* and agree with the original account of Boergesen (1914). Only plurilocular sporangia are present. Hamel (1931-39) considers this taxon to be conspecific with *Feldmannia irregularis*, but Earle (1969) maintains it as a distinct species. The status of the taxon will remain questionable until a critical study of all the ectocarpoid algae of the western tropical Atlantic is undertaken.

Giffordia mitchelliae (Harvey) Hamel 1939:XIV, Fig. 61c, d. Cardinal 1964:45, Fig. 23. Earle 1969:138, Fig. 24. Taylor 1960:206, pl. 29. Figs. 1-2.

Ectocarpus mitchelliae Harvey 1852, p. 142, pl. 12 g.
Boergesen 1914:6, Figs. 3-4. 1941:7, Figs. 1-5. Collins
and Hervey 1917:69.

TYPE LOCALITY: Nantucket Island, Massachusetts.

TYPE: TCD.

DISTRIBUTION: widespread in tropical and temperate seas.

SPECIMENS EXAMINED: Sargasso Sea: 31°N-69°29'W, 3.iii.1970, Volkmann (WJW 2361, 2381, 2383); 32°09'N-64°58'W, 16.v.1970, Woelkerling (WJW 2666); 34°N-70°W, 10.i.1970, Volkmann (WJW 2206, 2218); 39°07'N-70°35'W, 16.viii.1970, Moore (WJW 2925).

Specimens up to 5 cm tall occur as epiphytes on *Sargassum fluitans*, *S. natans*, and on an unidentified species of *Sargassum*. In all cases plurilocular sporangia are abundant.

Giffordia sandriana (Zanardini in Kuetzing) Hamel 1939:
XIV. Cardinal 1964:37, Fig. 18. Kylin 1947:10, Fig. 3.
Taylor 1960:207.

Ectocarpus sandrianus Zanardini in Kuetzing 1849:451.

Rosenvinge et Lund 1941:44, Fig. 18.

TYPE LOCALITY: Adriatic Sea.

TYPE: L.

DISTRIBUTION: Bermuda, Europe, Sargasso Sea.

SPECIMENS EXAMINED: Sargasso Sea: 34°N-70°W, 7.iii.1970, Volkmann (WJW 2414).

Plants up to 5 cm tall occurred as epiphytes on *Sargassum fluitans* and bore plurilocular sporangia.

Genus *Pylaiella* Bory, 1823

Pylaiella littoralis (L.) Kjellman. Cardinal 1964:11, Fig. 1.
Rosenvinge et Lund 1941:5. Taylor 1957:102, pl. 9, Figs.
1-3. Woelkerling 1972:298.

TYPE LOCALITY: Europe.

TYPE: LINN.

DISTRIBUTION: widespread.

SPECIMENS EXAMINED: Sargasso Sea: 38°53'N-69°39'W, 10.v.1970, Woelkerling (WJW 2559); 39°11'N-69°24'W, 10.v.1970, Woelkerling (WJW 2555).

The plants were found as epiphytes on *Fucus vesiculosus* along the northwest fringes of the Sargasso Sea and probably should not be considered as a permanent component of the Sargasso Sea flora (Woelkerling, 1972).

ORDER SPHACELARIALES

Family Sphacelariaceae

Genus *Sphacelaria* Lyngbye, 1819

Sphacelaria fucigera Kuetszing. Sauvageau 1901:145, Fig. 35. Taylor 1960:210, pl. 29, Fig. 5. Womersley 1967:199.

TYPE LOCALITY: Karak Island, Persian Gulf.

TYPE: L (937/71/472).

DISTRIBUTION: cosmopolitan in tropical and temperate waters.

SPECIMENS EXAMINED: Sargasso Sea: 34°N-70°W, 10.i.1970, *Volkmann* (WJW 2202); 38°22'N-70°58'W, 12.x.1970, *Volkmann* (WJW 2896); 39°07'N-70°35'W, 16.viii.1970, *Moore* (WJW 2921).

The plants were epiphytic on *Sargassum natans* and an unidentified *Sargassum* and bore numerous propagula. One collection (WJW 2921) also had numerous multicellular hairs.

ORDER DICTYOTALES

Family Dictyotaceae

Genus *Dictyota* Lamouroux, 1809

Dictyota sp.

Two collections [32°09'N-64°58'W, 16.v.1970, *Woelkerling* (WJW 2658) and 39°30'N-71°W, 6.x.1970, *Volkmann* (WJW 2877)] of small plants referable to *Dictyota* have been made during this study. The former, which contained both male and female reproductive structures and was about 5 cm tall, was found growing on a fragment of *Colpomenia*, which probably became detached and drifted out from the shores of Bermuda. It apparently shares a number of features with *D. dichotoma*, but definite specific determination was not considered possible.

The latter plants were attached to a fertile piece of *Sargassum* (origin uncertain) and were very young (less than 2 cm tall); specific determination likewise could not be made. It seems more probable that *Dictyota* is an invader rather than a permanent component of the Sargasso Sea flora considering that both host plants themselves appear to be invaders.

Prat (1935, p. 128) makes mention of a *Dictyota cervicornis* from this region, but no specimens referable to that species have been encountered during the present study.

Genus *Padina* Adanson, 1763

Padina sp.

A very young *Padina* plant [32°09'N-64°58'W, 16.v.1970, *Woelkerling* (WJW 2657)] occurred on a piece of *Colpomenia* which apparently had drifted out from Bermuda. Specific determination was not possible and it seems probable that *Padina* is an invader rather than a permanent component of the Sargasso Sea flora.

ORDER CHORDARIALES

Family Elachisteaceae

Genus *Elachistea* Duby, 1830

Elachistea lubrica Ruprecht. Collins, Holden, and Setchell 1898:480. Taylor 1957:140. *Woelkerling* 1972:297.

TYPE LOCALITY: Okhotsk Sea.

TYPE: LE.

DISTRIBUTION: reported from eastern North America, Greenland, and the Okhotsk Sea.

SPECIMENS EXAMINED: Sargasso Sea: 38°53'N-69°39'W, 10.v.1970, *Woelkerling* (WJW 2564); 39°05'N-69°48'W, 10.v.1970, *Woelkerling* (WJW 2569); 39°11'N-69°24'W, 10.v.1970, *Woelkerling* (WJW 2547; 2556).

An invader species attached to drifting *Ascophyllum* and *Fucus* (see *Woelkerling*, 1972). The specimens have been referred to *Elachistea lubrica* because of the apparent absence of moniliform paraphyses (see Taylor, 1957, p. 139),

but critical study is needed to determine whether this is a reliable character of specific distinction. Lund (1959) and Rosenvinge (1893) have regarded *E. lubrica* as a variety of *E. fucicola*.

Family Chordariaceae

Genus *Chordaria* C. Agardh, 1817

Chordaria flagelliformis (Mueller) C. Agardh. Kylin 1947: 59, Figs. 51A, D. Lund 1959:121, Figs. 26, 27. Taylor 1957:148, pl. 12, Fig. 6; pl. 14, Fig. 4.

TYPE LOCALITY: Denmark.

TYPE: not located.

DISTRIBUTION: cooler waters of North America and Europe.

SPECIMENS EXAMINED: Sargasso Sea: 39°05'N-69°48'W, 10.v.1970, *Woelkerling* (WJW 2576); 39°11'N-69°24'W, 10.v.1970, *Woelkerling* (WJW 2554).

The plants were epiphytes on invading specimens of *Fucus* (see Woelkerling, 1972) and are not considered permanent components of the Sargasso Sea flora.

ORDER PUNCTARIALES

Family Punctariaceae

Genus *Colpomenia* Derbes and Solier, 1856

Colpomenia sinuosa (Roth) Derbes and Solier. Taylor 1928: 110, pl. 7, Fig. 1, pl. 19, Figs. 3-4; 1960:260, pl. 36, Fig. 1. Womersley 1967:244.

TYPE LOCALITY: Cadiz, Spain.

TYPE: probably lost.

DISTRIBUTION: widespread.

SPECIMEN EXAMINED: Sargasso Sea: 32°09'N-64°58'W, 16.v.1970, *Woelkerling* (WJW 2655).

The plant collected almost certainly drifted out into Sargasso Sea waters from Bermuda and does not represent a permanent component of the flora.

Genus *Petalonia* Derbes and Solier, 1850

Petalonia fascia (Mueller) Kuntze. Lund 1947:31, Fig. 10.
Taylor 1957:167, pl. 14, Fig. 5; pl.15, Fig. 3.

Ilea fascia (Mueller) Fries. Kylin 1947:77, Fig. 61A.

TYPE LOCALITY: Denmark.

TYPE: not located.

DISTRIBUTION: widespread.

SPECIMEN EXAMINED: Sargasso Sea: 39°11'N-69°24'W, 10.v.1970,
Woelkerling (WJW 2549).

This taxon is an invading element attached to *Fucus vesiculosus* (see *Woelkerling*, 1972).

Genus *Punctaria* Greville, 1830

Punctaria latifolia Greville. Collins, Holden, and Setchell
1895:82; 1901:873; 1907:1388. Taylor 1957:166, pl. 15,
Fig. 5.

TYPE LOCALITY: Great Britain.

TYPE: not located.

DISTRIBUTION: widespread.

SPECIMEN EXAMINED: Sargasso Sea: 39°05'N-69°48'W, 10.v.1970,
Woelkerling (WJW 2573).

A single, rather small and battered plant was found attached to an invading *Fucus* element (see *Woelkerling*, 1972).

Punctaria plantaginea (Roth) Greville. Rosenvinge et Lund
1947:11, Fig. 2; 1959:133, Fig. 28. Taylor 1957:166, pl.
15, Fig. 4; pl. 16, Fig. 4.

TYPE LOCALITY: Kattegat Channel between Denmark and
Sweden.

TYPE: probably destroyed.

DISTRIBUTION: widespread.

SPECIMENS EXAMINED: Sargasso Sea: 38°53'N-69°39'W, 10.v.1970,
Woelkerling (WJW 2560); 39°05'N-69°48'W, 10.v.1970, *Woelkerling*
(WJW 2575).

Two small plants occurred as epiphytes on *Fucus*; they are not considered permanent components of the Sargasso Sea flora (see *Woelkerling*, 1972).

Genus *Scytosiphon* C. Agardh, 1811

Scytosiphon lomentaria (Lyngbye) C. Agardh. Rosenvinge et Lund 1947:27, Fig. 9; 1959:103, Fig. 20. Taylor 1957:168, pl. 15, Fig. 2; pl. 16, Fig. 3.

TYPE LOCALITY: Denmark.

TYPE: C.

DISTRIBUTION: nearly cosmopolitan.

SPECIMENS EXAMINED: Sargasso Sea: 38°53'N-69°39'W, 10.v.1970, *Woelkerling* (WJW 2562); 39°05'N-69°48'W, 10.v.1970, *Woelkerling* (WJW 2574); 39°11'N-69°24'W, 10.v.1970, *Woelkerling* (WJW 2548).

These collections occurred as epiphytes on *Fucus* and probably do not represent permanent components of the Sargasso Sea flora. The species does, however, occur in Bermuda and along the southeastern U. S. Coast (Taylor, 1960), and may eventually be found to occur on *Sargassum fluitans* or *S. natans* in the Sargasso Sea.

Family Striariaceae

Genus *Isthmoplea* Kjellman, 1877

Isthmoplea sphaerophora (Harvey in Hooker) Kjellman. DeToni 1895:569. Kylin 1947:67, Figs. 56D-E. Taylor 1957:156, pl. 9, Figs. 4-5. Woelkerling 1972:298.

Ectocarpus sphaerophorus Carmichael. Harvey 1846: pl. CXXVI.

TYPE LOCALITY: Appin, Scotland.

TYPE: TCD.

DISTRIBUTION: cooler waters of Eastern North America and Europe.

SPECIMEN EXAMINED: Sargasso Sea: 38°53'N-69°39'W, 10.v.1970, *Woelkerling* (WJW 2566).

The single collection contains a number of fertile plants attached to *Polysiphonia lanosa*, in turn an epiphyte on a plant of *Ascophyllum*, which had drifted out into the Northwestern fringes of the Sargasso Sea (see Woelkerling, 1972).

ORDER FUCALES
Family Fucaceae

Genus *Ascophyllum* Stackhouse 1809

Ascophyllum nodosum (L.) Le Jolis. Kylin 1947:84. Taylor 1957:195, pl. 27, Figs. 1-2.

TYPE LOCALITY: Atlantic Ocean.

TYPE: LINN.

DISTRIBUTION: widespread in colder waters of the northern hemisphere.

SPECIMENS EXAMINED: Sargasso Sea: 38°53'N-69°39'W, 10.v.1970, *Woelkerling* (WJW 2558); 39°05'N-69°48'W, 10.v.1970, *Woelkerling* (WJW 2568); 39°11'N-69°24'W, 10.v.1970, *Woelkerling* (WJW 2546).

The plants were found adrift along the northwest fringes of the Sargasso Sea; there is some question as to whether they should be regarded as permanent components of the Sargasso Sea flora (see *Woelkerling*, 1972).

Genus *Fucus* Linneaus, 1753

Fucus vesiculosus L. Harvey 1852:71. Kylin 1947:83, Tab. 17, Figs. 53-54. Taylor 1957:192, pl. 25, Figs. 1-3.

TYPE LOCALITY: Atlantic Ocean.

TYPE: LINN.

DISTRIBUTION: widespread in colder waters of northern hemisphere.

SPECIMENS EXAMINED: Sargasso Sea: 38°53'N-69°39'W, 10.v.1970, *Woelkerling* (WJW 2563); 39°05'N-69°48'W, 10.v.1970, *Woelkerling* (WJW 2570); 39°11'N-69°24'W, 10.v.1970, *Woelkerling* (WJW 2557).

The plants were found adrift along the northwest fringes of the Sargasso Sea with *Ascophyllum* and *Sargassum natans* and bore a number of epiphytes (see *Woelkerling*, 1972).

Family Sargassaceae

Genus *Sargassum* C. Agardh, 1820

The tropical American Atlantic species of *Sargassum* are poorly known and specific limits and distinctions remain

very unclear (see Taylor, 1960, p. 268). Moreover, keys to species occurring in this region (e.g. Howe, 1920; Taylor, 1928, 1960) are based largely on vegetative features rather than on reproductive structures, which appear to be of more fundamental significance (Setchell, 1931; Womersley, 1954). The situation is further complicated by the fact that the two species of *Sargassum* most commonly found in the Sargasso Sea apparently have never been found in a fertile state (see, however, Parr, 1939).

During the course of this study, seven apparently distinct species of *Sargassum* have been found adrift in the western Sargasso Sea. Only three of these, however, have been identified with any certainty. The remaining four have not been definitely identified as yet and, following the approach of Winge (1923), are referred to here as *Sargassum* A, B, etc., to avoid further name confusion until such time as a critical monographic study of the genus is undertaken for this region.

Differences between the seven taxa are summarized as follows:

Conspectus of *Sargassum* Taxa in
the Western Sargasso Sea

1. Plants sterile, pelagic, without evidence of a basal holdfast. 2.
2. Stems smooth; vesicles often apiculate; leaves linear, up to 4 mm wide. *S. natans*.
2. Stems muriculate; vesicles at most muticous; leaves lanceolate, up to 8 mm wide. *S. fluitans*.
1. Plants commonly fertile, normally attached, usually showing evidence of a holdfast. 3.
3. Fruiting branches often carpophyllaceous (i.e. of mixed receptacles, leaves, and vesicles). 4.
4. Receptacles pedicellate; cryptostomata tending to be in a single row adjacent to the costa.
. "Sargassum D."

4. Receptacles not pedicellate; cryptostomata scattered. "Sargassum B."
3. Fruiting branches not carpophyllaceous (i.e. composed solely of receptacles). 5.
5. Receptacles pedicellate. 6.
6. Receptacles commonly spiny; costa not spiny or dentate.
Sargassum hystrix var. *buxifolium*.
6. Receptacles not spiny; costa prominently dentate to spiny. "Sargassum A."
5. Receptacles sessile. "Sargassum C."

Sargassum fluitans (Boergesen) Boergesen 1914a:6. Taylor 1928:127, pl. 18, Fig. 9; pl. 19, Fig. 5; 1960:281, pl. 39, Fig. 2, pl. 40, Fig. 7.

Sargassum hystrix J. Ag. var. *fluitans* Boergesen 1914a: 11, Fig. 8. Winge 1923:23, Fig. 6 (as "Sargassum III").

TYPE LOCALITY: Sargasso Sea.

TYPE: C.

DISTRIBUTION: known only from the Sargasso Sea.

SPECIMENS EXAMINED: Sargasso Sea: 21°58'N-68°20'W, 24.iv.1970, Moore (WJW 2639); 26°57'N-72°58'W, 26.iv.1970, Moore (WJW 2649); 28°N-70°W, 4.vii.1970, Volkmann (WJW 2738); 31°N-69°29'W, 3.iii.1970, Volkmann (WJW 2394); 31°N-70°W, 5.vii.1970, Volkmann (WJW 2731); 32°09'N-64°58'W, 16.v.1970, Woelkerling (WJW 2654); 33°58'N-69°56'W, 15.v.1970, Woelkerling (WJW 2602); 24°N-70°W, 10.i.1970, Volkmann (WJW 2224), 7.iii.1970, Volkmann (WJW 2418), 6.vii.1970, Volkmann (WJW 2742), 14.viii.1970, Moore (WJW 2933); 36°N-70°36'W, 9.xii.1970, Moore (WJW 2947); 37°N-70°W, 12.v.1970, Woelkerling (WJW 2616); 37°30'N-70°W, 8.vii.1970, Volkmann (WJW 2712); 38°34'N-69°11'W, 19.v.1970, Woelkerling (WJW 2606).

Sargassum fluitans is the less frequently encountered of the two species of *Sargassum* endemic to the Sargasso Sea but apparently enjoys almost as wide a distribution. The specimens examined during this study were commonly covered with bryozoans and to a lesser extent with epibiotic algae.

Sargassum hystrix J. Agardh var. *buxifolium* (Chauvin)

J. Agardh 1889:91, tab VII, Fig. 1. Boergesen 1914:221. Chapman 1963:45. Earle 1969:225, Fig. 118. Grunow 1915:399. Howe 1920:594. Taylor 1928:128, pl. 18, Fig. 1, pl. 19, Fig. 9; 1960:279, pl. 38, Fig. 2, pl. 40, Fig. 6.

TYPE LOCALITY: Caribbean Area (see DeToni 1895:53).

TYPE: LD(?).

DISTRIBUTION: Florida to Brazil, Caribbean Islands, Sargasso Sea.

SPECIMENS EXAMINED: Sargasso Sea: 36°N-70°36'W, 9.xii.1970, Moore (WJW 2912); 39°30'N-71°W, 6.x.1970, Volkmann (WJW 2873).

The specimens examined agree well with the descriptions and illustrations of Earle (1969) and Taylor (1960), and probably are the same as "*Sargassum* VI" of Winge (1923, p. 25, Fig. 10). The material was collected in the immediate vicinity of the Gulf Stream, the same region reported by Winge (1923), and apparently is known mainly from drift specimens (Earle, 1969; Taylor, 1928, 1960).

Both specimens bore non-carpophyllaceous receptacles which were simple or once fucate, terete or slightly compressed, verrucose or occasionally with odd spines, pedicellate, and more or less racemose.

Sargassum natans L. Boergesen 1914a:7, Figs. 3-7. Taylor 1928:128, pl. 18, Figs. 2-4, pl. 19, Fig. 13; 1960: pl. 37, Fig. 2, pl. 40, Figs. 3, 8. Winge 1923:24, Figs. 3-5 (as "*Sargassum* I & III").

TYPE LOCALITY: Sargasso Sea.

TYPE: LINN.

DISTRIBUTION: known only from the Sargasso Sea.

SPECIMENS EXAMINED: Sargasso Sea: 20°50'N-67°15'W, 24.iv.1970, Moore (WJW 2645); 21°58'N-68°20'W, 24.iv.1970, Moore (WJW 2640); 26°50'N-71°48'W, 5.iii.1970, Volkmann (WJW 2422); 26°57'N-72°58'W, 26.iv.1970, Moore (WJW 2653); 28°N-70°W, 4.iii.1970, Volkmann (WJW 2437), 4.vii.1970, Volkmann (WJW 2739), 31°N-69°29'W, 3.iii.1970, Volkmann (WJW 2393); 31°N-70°W, 5.vii.1970, Volkmann (WJW 2732); 32°09'N-64°58'W, 16.v.1970, Woelkerling (WJW 2662); 34°N-70°W, 10.i.1970, Volkmann (WJW 2223), 7.iii.

1970, *Volkman* (WJW 2417), 13.v.1970, *Volkman* (WJW 2607), 30.vi.1970, *Volkman* (WJW 2723), 6.vii.1970, *Volkman* (WJW 2743), 14.viii.1970, *Volkman* (WJW 2931); 35°54'N-70°30'W, 13.viii.1970, *Moore* (WJW 2904); 36°N-70°36'W, 9.xii.1970, *Moore* (WJW 2950); 36°28'N-70°29'W, 15.viii.1970, *Moore* (WJW 2905); 37°N-70°W, 12.v.1970, *Woelkerling* (WJW 2617); 37°30'N-70°W, 8.vii.1970, *Woelkerling* (WJW 2711); 38°22'N-70°58'W, 12.x.1970, *Volkman* (WJW 2897); 38°34'N-69°11'W, 19.v.1970, *Woelkerling* (WJW 2605); 39°07'N-70°35'W, 16.viii.1970, *Moore* (WJW 2909); 39°11'N-69°24'W, 10.v.1970, *Woelkerling* (WJW 2644).

Sargassum natans plants comprise the vast bulk of the Sargasso Sea macroscopic vegetation, estimated by Parr (1939) to be up to 40 million metric tons. It also harbored the greatest variety and quantity of epibiotic algae. The considerable quantities of *S. natans* which wash up on the shores of Bermuda, in contrast, are apparently devoid of epiphytes (Woelkerling, personal observations).

"*Sargassum* A"

The single specimen [39°30'N-70°W, 6.x.1970, *Volkman* (WJW 2867)] referred to this "taxon" bears a small, discoid holdfast and a sparsely branched, nearly terete main axis with a few, scattered, long laterals whose stems are muriculate. The leaves are lanceolate, up to 3 mm broad and 30 mm long, finely serrate, with a prominent dentate to spiny costa. Cryptostomata are lacking. Vesicles up to 5 mm in diameter are mostly single and pedicellate and scattered among the leaves.

The receptacles are not carpophyllaceous, and are simple or up to several times furcate, terete, verrucose, not spiny or dentate, pedicellate, racemose, and up to 10 mm long.

While these features are most closely associated with *Sargassum filipendula* var. *montagnei* as described in Taylor (1960), definite specific affiliation of the specimen in question remains uncertain.

"*Sargassum* B"

The single specimen [34°N-70°W, 10.i.1970, *Volkman* (WJW 2222)] lacks a holdfast and has a smooth stem with a number of short lateral branches. The leaves are mostly

lanceolate ovate, up to 5 mm broad and 30 mm long, serrate, have costae without ridges or wings and bear scattered cryptostomata. Vesicles up to 6 mm broad are short pedicellate and are scattered among the leaves and receptacles.

The receptacles are generally carpophyllaceous and usually 2-4 times furcate, are terete, not dentate or spiny, are not pedicellate and are borne in dense cymose clusters.

Although this taxon shows many of the features of *Sargassum vulgare* C. Agardh as described in Taylor (1960), final specific identification remains uncertain.

“*Sargassum C*”

The single specimen [33°58.5'N-69°56.5'W, 15.v.1970, *Woelkerling* (WJW 2589)] lacks a holdfast and has muriculate stems bearing lateral branches of variable length. The leaves are linear lanceolate, up to 3 mm broad and 30 mm long, entire or finely serrate, and bear inconspicuous costae and scattered cryptostomata. Shortly pedicellate vesicles up to 5 mm in diameter are scattered along the branches.

The receptacles generally are not carpophyllaceous, are one to several times furcate, terete, verrucose, generally not pedicellate, and are racemose.

This specimen could not be linked to any of the species described by Taylor (1960). In some respects it is similar to what Taylor (1960) calls *Sargassum filipendula* var. *montagnei*, but differs in the nature of the costa and in having non-pedicellate receptacles.

“*Sargassum D*”

The one specimen [34°N-70°W, 10.i.1970, *Volkmann* (WJW 2225)] lacks a holdfast and has a stem that is muriculate in the younger portions and smooth in the older portions. Lateral branches vary in length and bear lanceolate leaves up to 3 mm broad and 30 mm long which are mostly entire, costate, and bear cryptostomata which tend to lie in a single row on each side of the costa. Shortly pedicellate vesicles up to 5 mm in diameter are scattered along the lateral branches.

The receptacles are carpophyllaceous, simple or once furcate, terete, not dentate or spiny, pedicellate, and generally cymose.

Of the species described by Taylor (1960), this specimen most closely approximates *Sargassum acinarium* (L.) C. Agardh, but apparent differences in receptacle morphology leaves some doubt as to the specimen's true affinities.

A second specimen [37°N-70°W, 12.v.1970, *Woelkerling* (WJW 2673)] shares many features with "*Sargassum D*" including the linear distribution of cryptostomata, but the racemose nature of the receptacles leaves some doubt as to its exact relationships until further material becomes available for study.

CLASS RHODOPHYCEAE

SUBCLASS BANGIOPHYCIDAE

ORDER BANGIALES

Family Bangiaceae

Genus *Asterocytis* Gobi, 1879

Asterocytis ramosa (Twaites in Harvey) Gobi. Boergesen 1915:3, Fig. 1. Chapman 1963:49. Kylin 1944:6, Fig. 1d-f. Rosenvinge 1909:77, Fig. 17. Taylor 1928:132, pl. 20, Figs. 1-2; 1960:287. Wille 1900:7, Tab. 1, Figs. 8-14.

Hormospora ramosa Twaites in Harvey 1846-51:Pl. CCXII.

TYPE LOCALITY: Wareham, Dorsetshire, Great Britain.
TYPE: TCD.

DISTRIBUTION: widespread.

SPECIMENS EXAMINED: Sargasso Sea: 37°N-70°W, 12.v.1970, *Woelkerling* (WJW 3957); 39°07'N-70°35'W, 16.viii.1970, *Moore* (WJW 2920).

In both cases the plants were epiphytic on *Cladophora* which, in turn, was growing on *Sargassum natans*.

Hamel (1924), Boergesen (1927), and Pham Hoang-Ho (1969), among others, have referred this species to the synonymy of *Asterocystis ornata* (C. Agardh) Hamel.

Kylin (1944) and Taylor (1957, 1960), however, prefer to separate the two taxa on grounds that *A. ramosa* is marine and *A. ornata* freshwater. The validity of such a separation requires further investigation, and until new evidence comes to light, the two taxa will be kept distinct for purposes of the present study.

Genus *Erythrocladia* Rosenvinge, 1909

Erythrocladia subintegra Rosenvinge 1909:73, Figs. 13-14. Boergesen 1915:7, Figs. 3-4. Collins and Hervey 1917:95. Pham-Hoang-Ho 1969:80, Figs. 2-12. Taylor 1960:290. TYPE LOCALITY: Hirshals, Skagerak, Denmark.

TYPE: C.

DISTRIBUTION: Europe, western tropical Atlantic, Southeast Asia.

SPECIMENS EXAMINED: Sargasso Sea: 31°N-69°29'W, 3.iii.1970, *Volkman* (WJW 2387, 2391, 2392); 34°N-70°W, 10.i.1970, *Volkman* (WJW 2212), 7.iii.1970, *Volkman* (WJW 2405, 2406); 36°N-70°36'W, 9.xii.1970, *Moore* (WJW 2939, 2940).

All specimens occurred as epiphytes on hydroids which, in turn, were growing on *Sargassum fluitans*, *S. natans*, or *Sargassum* sp.

Erythrocladia recondita Howe et Hoyt 1916:112, pl. 12, Figs. 1-5, pl. 13, Fig. 1. Hoyt 1920:467, pl. CXVI, Fig. 1, pl. CXVII, Figs. 1-5.

TYPE LOCALITY: Beaufort, North Carolina.

TYPE: NY.

DISTRIBUTION: type locality, Sargasso Sea.

SPECIMEN EXAMINED: Sargasso Sea: 39°30'N-71°W, 6.x.1970, *Volkman* (WJW 2866).

The specimens occurred epizoically on hydroids which in turn grew on an unidentified *Sargassum*.

Genus *Erythrotrichia* Areschoug, 1850

Erythrotrichia carnea (Dillwyn) J. Agardh. Boergesen 1915:7. Collins and Hervey 1917:94. Hoyt 1920:466, Fig. 24. Rosenvinge 1909:67, Fig. 8. Taylor 1957:202, pl. 28, Figs. 13-15; 1960:292. Woelkerling 1972:298.

TYPE LOCALITY: Great Britain.

TYPE: NMW.

DISTRIBUTION: widespread.

SPECIMENS EXAMINED: Sargasso Sea: 28°N-70°W, 4.iii.1970, *Volkmann* (WJW 2433); 31°N-69°29'W, 3.iii.1970, *Volkmann* (WJW 2360; 2390); 34°N-70°W, 10.i.1970, *Volkmann* (WJW 2216), 7.iii.1970, *Volkmann* (WJW 2404); 39°11'N-69°24'W, 10.v.1970, *Woelkerling* (WJW 2551).

With the exception of the last cited specimen, all plants occurred epizoically on hydroids which in turn were attached to *Sargassum fluitans*, *S. natans*, or *Sargassum* sp. In the other collection, the plants occurred epiphytically on *Fucus* (*Woelkerling*, 1972).

SUBCLASS FLORIDEOPHYCIDAE

ORDER NEMALIALES

Family Acrochaetiaceae

Four species of *Audouinella* (*A. daviesii*, *A. hallandica*, *A. microscopica*, *A. saviana* [= *A. thuretii*]) and two species of *Colaonema* (*C. infestans*, *C. secundata*) occur in the western Sargasso Sea and are the subject of a recent detailed morphotaxonomic study (*Woelkerling*, 1973).

ORDER CRYPTONEMIALES

Family Corallinaceae

Subfamily Corallineae

Genus *Jania* Lamouroux, 1812

Jania adherens Lamouroux. Boergesen 1917:195, Figs. 184-187. Chapman 1963:86, Fig. 85. Taylor 1928:205. Howe 1920:589. 1960:413, pl. 49, Figs. 1-2.

TYPE LOCALITY: Mediterranean Sea.

TYPE: not located.

DISTRIBUTION: widespread in tropical and warm temperate waters.

SPECIMEN EXAMINED: Sargasso Sea: 32°09'N-65°58'W, 16.v.1970, *Woelkerling* (WJW 2656).

The single collection occurred as an epiphyte on a plant of *Colpomenia* (q.v.) which probably drifted out from the

Bermuda Islands; consequently this species of *Jania* probably does not represent a permanent component of the Sargasso Sea flora.

Jania capillacea Harvey 1853:85. Boergesen 1917:198, Fig. 188. Chapman 1963:86, Fig. 86. Collins, Holden, and Setchell 1895:150. Howe 1920:589. Taylor 1928:206, pl. 29, Figs. 2, 10. 1960:413, pl. 49, Figs. 1-2.

TYPE LOCALITY: Bahia Honda, Florida.

TYPE: TCD.

DISTRIBUTION: tropical western Atlantic.

SPECIMENS EXAMINED: Sargasso Sea: 31°N-69°29'W, 3.iii.1970, *Volkmann* (WJW 2217); 36°N-70°36'W, 9.xii.1970, *Moore* (WJW 2945); 39°07'N-70°35'W, 16.viii.1970, *Moore* (WJW 2926).

Jania capillacea has been found growing on *Sargassum fluitans*, *S. natans*, and on several unidentified *Sargassum* taxa. Prat (1935) previously reported this taxon from the Sargasso Sea.

Subfamily Melobesieae

Genus *Fosliella* Howe, 1920

Fosliella farinosa (Lamouroux) Howe 1920:587. Chapman 1963:91, Fig. 92. Dawson 1960:30, pl. 21, Fig. 1, pl. 22, Fig. 1. Taylor 1960:388. Womersley and Bailey 1970:309.

Melobesia farinosa Lamouroux. Lemoine in Boergesen 1917:170, Fig. 165. Hoyt 1920:523, Fig. 47. Taylor 1928:211.

TYPE LOCALITY: Adriatic Sea.

TYPE: CN.

DISTRIBUTION: nearly cosmopolitan.

SPECIMENS EXAMINED: Sargasso Sea: 31°N-69°29'W, 3.iii.1970, *Volkmann* (WJW 2355); 34°N-70°W, 13.v.1970, *Woelkerling* (WJW 2608).

The plants occurred epiphytically on *Sargassum fluitans* and *S. natans*.

Fosliella lejolisii (Rosanoff) Howe 1920:588. Masaki 1968:23, pls. XII, XLIX, L. Taylor 1957:253, pl. 36, Figs. 6-8.

Melobesia lejolisii Rosanoff 1866:62, pl. 1, Figs. 1-13, pl. 7, Figs. 9-11. Rosenvinge 1917:238, Figs. 156-159.

TYPE LOCALITY: Cherbourg, France.

TYPE: not located.

DISTRIBUTION: Europe, Atlantic North America, Japan, Sargasso Sea.

SPECIMENS EXAMINED: Sargasso Sea: 28°N-70°W, 4.iii.1970, *Volkmann* (WJW 2436); 31°N-69°29'W, 3.iii.1970, *Volkmann* (WJW 2356, 2378); 32°09'N-64°58'W, 16.v.1970, *Woelkerling* (WJW 2659, 2672); 33°58.5'N-69°56.5'W, 15.v.1970, *Woelkerling* (WJW 2590, 2600); 34°N-70°W, 7.iii.1970, *Volkmann* (WJW 2400, 2402); 36°N-70°36'W, 9.xii.1970, *Moore* (WJW 2946, 2948); 37°N-70°W, 12.v.1970, *Woelkerling* (WJW 2634); 39°07'N-70°35'W, 16.viii.1970, *Moore* (WJW 2928).

Fosliella lejolesii occurs as an epiphyte on *Sargassum fluitans*, *S. natans*, *Sargassum* sp. as well as on other algae, and in terms of numbers of individuals, is probably the most common red alga in the Sargasso Sea. Only *Ceramium gracillimum* (q.v.) approaches the same quantitative frequency.

According to Taylor (1960, p. 387) *Fosliella lejolisii* is distinguished from *L. affinis* and *L. bermudense* by having thallus cells 6-7 μ m broad rather than 9-18 μ m broad or 10-12 μ m broad. However, cells up to 13 μ m broad were found in Sargasso Sea collections, and this suggests that the relationships of the three taxa require critical reinvestigation.

ORDER CERAMIALES
Family Ceramiaceae

Genus *Antithamnion* Naegeli, 1847

Antithamnion antillarum Boergesen 1917:226, Figs. 213-216. Taylor 1960:499. Womersley and Bailey 1970:322.

TYPE LOCALITY: St. Thomas, Virgin Islands.

TYPE: C.

DISTRIBUTION: Virgin Islands, Sargasso Sea, tropical Pacific Ocean.

SPECIMENS EXAMINED: Sargasso Sea: 28°N-70°W, 4.iii.1970, *Volkmann* (WJW 2426); 31°N-69°29'W, 3.iii.1970, *Volkmann* (WJW 2376).

In both cases, plants occurred epiphytically on *Sargassum natans*. One (WJW 2376) bore tetrasporangia; the other was sterile. The genus *Antithamnion* in this area needs critical reinvestigation in light of recent studies of Wollaston (1968, 1971) on southern Australian and Pacific Coast species.

Genus *Ceramium* Roth, 1797

Ceramium gracillimum (Kuetzing) Griffiths and Harvey. Dawson 1962:57, pl. 20, Figs. 2-3. Feldmann-Mazoyer in Boergesen 1952:42, Fig. 21. Nakamura 1965:136, pl. 1, 5-6, Fig. 6.

Ceramium gracillimum var. *byssoideum* (Harvey) Mazoyer 1938:323. Chapman 1963:178, Fig. 186. Feldmann-Mazoyer 1940:293, Fig. 109.

Ceramium byssoideum Harvey 1853:218. Taylor 1928:190, pl. 27, Figs. 20, 21; 1960:528, pl. 67, Figs. 1-3.

Ceramium transversale Collins and Hervey 1917:145, pl. 5, Figs. 29-31. Boergesen 1918:243.

TYPE LOCALITY: Trieste, Italy.

TYPE: C.

DISTRIBUTION: widespread in tropical and warm temperate seas; England.

SPECIMENS EXAMINED: Sargasso Sea: 21°58.5'N-68°20'W, 24.iv.1970, *Moore* (WJW 2642); 26°50'N-71°48'W, 5.iii.1970, *Volkmann* (WJW 2419); 26°57'N-72°58'W, 26.iv.1970, *Woelkerling* (WJW 2652); 28°N-70°W, 4.iii.1970, *Volkmann* (WJW 2428); 31°N-70°W, 5.vii.1970, *Volkmann* (WJW 2733); 32°09'N-64°58'W, 16.v.1970, *Woelkerling* (WJW 2661, 2669); 33°58.5'N-69°56.5'W, 16.v.1970, *Woelkerling* (WJW 2591); 34°N-70°W, 13.v.1970, *Woelkerling* (WJW 2609), 6.vii.1970, *Volkmann* (WJW 2746); 35°54'N-70°30'W, 13.viii.1970, *Moore* (WJW 2903); 37°N-70°W, 12.v.1970, *Woelkerling* (WJW 2619); 37°30'N-70°W, 8.vii.1970, *Volkmann* (WJW 2705); 38°22'N-70°58'W, 12.x.1970, *Volkmann* (WJW 2890).

Ceramium gracillimum is a common epiphyte on *Sargassum fluitans*, *S. natans*, and *Sargassum* sp. as well as on

other algae attached to *Sargassum* and often occurs in considerable numbers. One collection (WJW 2619) bore tetrasporangial individuals; the remainder were sterile.

Taylor (1960, p. 528) maintains *Ceramium byssoideum* and *C. gracillimum* as distinct taxa; however, following Feldmann-Mazoyer (1940), Nakamura (1965) and others the former is referred to the conspecificity of the latter. Likewise, *C. transversale* is regarded as conspecific in accordance with Feldmann-Mazoyer (1940).

Ceramium fastigiatum Harvey in Hooker [non *C. fastigiatum* Roth = *Polysiphonia fastigiata* (Roth) Greville]. Boergesen 1918:241, Fig. 231. Chapman 1963:177, Fig. 184a-c. Nakamura 1965:129, pl. 1(3), Fig. 4. Taylor 1928:191; 1957:309, pl. 47, Figs. 3-5, 7, pl. 48, Figs. 2-4, pl. 49, Figs. 3-4, pl. 50, Fig. 4, pl. 51, Figs. 6-7; 1960:526, pl. 67, Figs. 4-6.

TYPE LOCALITY: Great Britain.

TYPE: TCD.

DISTRIBUTION: widespread.

SPECIMENS EXAMINED: Sargasso Sea: 28°N-70°W, 4.iii.1970, *Volkmann* (WJW 2427); 31°N-69°29'W, 3.iii.1970, *Volkmann* (WJW 2348, 2370, 2373); 34°N-70°W, 7.iii.1970, *Volkmann* (WJW 2395); 39°07'N-70°35'W, 16.viii.1970, *Moore* (WJW 2923).

This taxon occurs as an epiphyte on *Sargassum fluitans*, *S. natans*, and *Sargassum* sp. All specimens examined were sterile. The author citations of Taylor (1960) and Boergesen (1918) (i.e. *C. fastigiatum* (Roth) Harvey) are incorrect; Roth's taxon was described from Germany and has been referred by Greville (1824) to *Polysiphonia* (see DeToni, 1903, p. 945-6) whereas Harvey's taxon was described from Great Britain (Harvey in Hooker, 1833).

Genus *Crouania* J. Agardh, 1842

Crouania attenuata (C. Agardh) J. Agardh, Boergesen 1917:230, Figs. 219-221. Chapman 1963:167, Fig. 173. Collins and Hervey 1917:142. Harvey 1853:226, Tab. XXXI, D. Taylor 1928:193, pl. 27, Figs. 7-9, pl. 32, Fig. 9.

TYPE LOCALITY: Mediterranean Sea.

TYPE: LD.

DISTRIBUTION: Mediterranean, England, tropical western Atlantic Ocean, Japan.

SPECIMENS EXAMINED: Sargasso Sea: 37°N-70°W, 12.v.1970, *Woelkerling* (WJW 2626); 39°30'N-71°W, 6.x.1970, *Volkman* (WJW 2882).

Male (WJW 2626) and tetrasporangial (WJW 2882) individuals occurred as epiphytes on *Sargassum natans* and on *Sargassum* sp.

Genus *Griffithsia* C. Agardh, 1817

Griffithsia radicans Kuetzing 1862:11, tab. 33, Fig. A-C. Taylor 1960:515.

TYPE LOCALITY: Brazil.

TYPE: L.

DISTRIBUTION: Brazil, Sargasso Sea.

SPECIMENS EXAMINED: Sargasso Sea: 37°N-70°W, 12.v.1970, *Woelkerling* (WJW 2629); 39°30'N-71°W, 6.x.1970, *Volkman* (WJW 2881).

The plants occurred as epiphytes on *Sargassum natans* and *Sargassum* sp. and appeared to have some tetrasporangial initials. They are referred to this species because of their agreement with the description given by Taylor (1960).

Genus *Spermothamnion* Areschoug, 1847

Spermothamnion investiens (Crouan in Maze et Schramm) Vickers. Boergesen 1909:17, Fig. 10; 1917:200, Figs. 189-190; 1920:461, Fig. 422. Collins and Hervey 1917:132. Howe 1920:578. Taylor 1960:520.

TYPE LOCALITY: Guadeloupe.

TYPE: PC.

DISTRIBUTION: North Carolina, Caribbean Islands, Sargasso Sea.

SPECIMENS EXAMINED: Sargasso Sea: 39°30'N-71°W, 6.x.1970, *Volkman* (WJW 2863).

Female and tetrasporangial plants were found as epiphytes on "*Sargassum* A" and may not, therefore, be a

permanent component of the Sargasso Sea flora. Tropical and subtropical western Atlantic members of the Spermothermaceae are in need of thorough reinvestigation in light of the recent study of Gordon (1972).

Genus *Wrangelia* C. Agardh, 1828

Wrangelia argus (Montagne) Montagne. Boergesen 1916: 116, Figs. 125-6. Gordon 1972:40. Taylor 1928:144, pl. 20, Fig. 13, pl. 22, Fig. 6, pl. 32, Fig. 4; 1960:502, pl. 66, Figs. 7-8.

TYPE LOCALITY: unknown.

TYPE: probably c.

DISTRIBUTION: see Gordon 1972, p. 40.

SPECIMENS EXAMINED: Sargasso Sea: 31°N-69°29'W, 3.iii.1970, *Volkman* (WJW 2371); 37°N-70°W, 12.v.1970, *Woelkerling* (WJW 2628); 39°30'N-71°W, 6.x.1970, *Volkman* (WJW 2880).

Male and tetrasporangial plants occurred as epiphytes on *Sargassum natans* and on *Sargassum* sp.

Family Dasyaceae

Genus *Dasya* C. Agardh, 1824

Dasya rigidula (Kuetzing) Ardisson. Howe 1920:576. Taylor 1960:558, pl. 72, Fig. 4.

TYPE LOCALITY: Spalato, Adriatic Sea.

TYPE: L.

DISTRIBUTION: Bermuda, Caribbean Islands, Mexico, Sargasso Sea, Venezuela, Adriatic and Mediterranean Seas.

SPECIMENS EXAMINED: Sargasso Sea: 34°N-70°W, 7.iii.1970, *Volkman* (WJW 2398); 36°N-70°36'W, 9.xii.1970, *Moore* (WJW 2941); 39°30'N-71°W, 6.x.1970, *Volkman* (WJW 2861, 2884).

Male, female, and tetrasporangial plants occurred epiphytically on *Sargassum fluitans* and on *Sargassum* sp.

Genus *Heterosiphonia* Montagne, 1842

Heterosiphonia wurdemanni (Bailey in Harvey) Falkenberg 1901:638, pl. 16, Fig. 11. Boergesen 1919:324, Figs. 326-328. Collins and Hervey 1917:131. Howe 1920:575. Taylor 1928:178, pl. 25, Fig. 3; 1960:565, pl. 72, Fig. 9.

Dasya wurdemanni Bailey in Harvey 1853:64, Tab. XV, C.

TYPE LOCALITY: Key West, Florida.

TYPE: TCD.

DISTRIBUTION: western tropical Atlantic; Mediterranean.

SPECIMENS EXAMINED: Sargasso Sea: 34°N-70°W, 10.i.1970, *Volkman* (WJW 2213).

A single tetrasporangial plant occurred epiphytically on “*Sargassum* B”; its status in the Sargasso Sea flora must remain in doubt until further collections come to hand.

Family Delesseriaceae

Genus *Hypoglossum* Kuetzing, 1843

Hypoglossum tenuifolium (Harvey) J. Agardh. Howe 1920: 564. Taylor 1960:545, pl. 68, Fig. 2.

Delesseria tenuifolia Harvey 1853:97, Tab. XXII, Fig. B.

Boergesen 1919:344, Figs. 340-343.

TYPE LOCALITY: Key West, Florida.

TYPE: TCD.

DISTRIBUTION: western tropical Atlantic Ocean.

SPECIMENS EXAMINED: Sargasso Sea: 34°N-70°W, 10.i.1970, *Volkman* (WJW 2220).

A single plant was found epiphytically on “*Sargaassum* B”, and until further collections come to hand, its status as a permanent component of the Sargasso Sea flora must remain in doubt.

Family Rhodomelaceae

Genus *Chondria* C. Agardh, 1817

Two collections — one tetrasporangial [37°N-70°W, 12.v.1970, *Woelkerling* (WJW 2632)] and one sterile [39°07'N-70°35'W, 16.viii.1970, *Moore* (WJW 2910)] — contained very small (less than 1 cm long) plants of *Chondria* attached to *Sargassum natans*. While both plants appear to come close to the diagnosis of *Chondria dasyphila* (Woodward) C. Agardh provided by Taylor (1960, p. 616), specific affinity could not be determined with certainty on the basis of the material at hand.

Genus *Herposiphonia* Naegeli, 1846

Herposiphonia secunda (C. Agardh) Ambronn. Boergesen 1920:469, Figs. 428-429. Chapman 1963:125, Figs. 130 a-b. Collins and Hervey 1917:126. Howe 1920:574. Taylor 1928:176, pl. 25, Figs. 8-10; 1960:604, pl. 72, Figs. 10-11.

TYPE LOCALITY: LD.

TYPE: LD.

DISTRIBUTION: western tropical Atlantic Ocean, Mediterranean Sea, Adriatic Sea.

SPECIMENS EXAMINED: Sargasso Sea: 31°N-69°20'W, 3.iii.1970, *Volkman* (WJW 2362); 32°09'N-64°58'W, 16.v.1970, *Woelkerling* (WJW 2660); 36°N-70°36'W, 9.xii.1970, *Moore* (WJW 2935); 37°N-70°W, 12.v.1970, *Woelkerling* (WJW 2630); 39°07'N-70°35'W, 16.viii.1970, *Moore* (WJW 2911); 39°30'N-71°W, 6.x.1970, *Volkman* (WJW 2864).

Male, female and tetrasporangial plants have been found on *Sargassum fluitans*, *S. natans*, and on *Sargassum* sp.

Herposiphonia tenella (C. Agardh) Naegeli. Boergesen 1918:286, Figs. 287-289; 1920:472, Fig. 430. Chapman 1963:127, Fig. 133. Collins and Hervey 1917:126. Howe 1920:573. Taylor 1928:177, pl. 25, Fig. 11; 1960:604, pl. 72, Fig. 12.

TYPE LOCALITY: Sicily.

TYPE: LD.

DISTRIBUTION: western tropical Atlantic Ocean; Mediterranean and Adriatic Seas.

SPECIMENS EXAMINED: Sargasso Sea: 33°58.5'N-69°56.5'W, 15.v.1970, *Woelkerling* (WJW 2596); 39°30'N-71°W, 6.x.1970, *Volkman* (WJW 2875).

The tetrasporangial specimens (WJW 2875) grew epiphytically on *Sargassum hystrix*; the sterile material was found on "*Sargassum* C." Until specimens attached to *S. fluitans* and/or *S. natans* are collected the status of this taxon as a permanent component of the Sargasso Sea remains in doubt.

Genus *Laurencia* Lamouroux, 1813

Tropical Atlantic American species of *Laurencia* are in need of critical study in light of the recent investigations of Saito (1967, 1969). Saito (1967, p. 72-73) recognizes 5 subgenera of *Laurencia* based on the presence or absence of secondary pit connections in the cortex, shape of cortical cells, presence or absence of lenticular thickenings in medullary cell walls, and plant form (compressed or cylindrical). Taylor (1960) does not provide full information on these features, and his keys are based partly on features of questionable taxonomic significance, thus making specific identification of taxa difficult.

Seven collections of *Laurencia* have been made during the present study, but in view of their small size (mostly under 1 cm tall) and with one exception their sterile condition, species affinities have not been determined. One of these [34°N-70°W, 30.vi.1970, *Volkman* (WJW 2729)] belongs to the subgenus *Palisadae*; the other six [31°N-69°29'W, 3.iii.1970, *Volkman* (WJW 2361); 33°58.5'N-69°56.5'W, 15.v.1970, *Woelkerling* (WJW 2593); 34°N-70°W, 6.vii.1970, *Volkman* (WJW 2745); 37°N-70°W, 12.v.1970, *Woelkerling* (WJW 2636); 37°30'N-70°W, 8.vii.1970, *Volkman* (WJW 2710); 39°30'N-71°W, 6.x.1970, *Volkman* (WJW 2874)] belong to the subgenus *Chondrophyucus*. The specimens occurred as epiphytes on *Sargassum natans* and on *Sargassum* sp.

Genus *Lophosiphonia* Falkenberg, 1897

Lophosiphonia cristata Falkenberg 1901:499, Tab. 9, Figs. 7-10. Boergesen 1918:297, Figs. 295-298. Chapman 1964:125, Fig. 129. Hollenberg 1958:68. Taylor 1960:606.

TYPE LOCALITY: Scogliera, Puntadel Posilipo, Gulf of Napal.

TYPE: not located.

DISTRIBUTION: Mediterranean, Bermuda, Bahamas, Jamaica, Virgin Islands, Sargasso Sea.

SPECIMEN EXAMINED: Sargasso Sea: 31°N, 69°29'W, 3.iii.1970, Volkmann (WJW 2363).

The single collection contained tetrasporangial plants epiphytic on *Sargassum fluitans*.

Genus *Polysiphonia* Greville, 1824

As noted by Taylor (1960, p. 572-3), much taxonomic uncertainty exists over tropical American Atlantic species of *Polysiphonia*, and a critical revision of the genus for this region is badly needed. Although several sources (including Taylor, 1960) have been consulted during this study, taxonomic identifications of Sargasso Sea collections have been made mainly from the publications of Hollenberg (1968, 1968a). The relationships of Hollenberg's Pacific taxa to the species names employed by Taylor (1960) for tropical American Atlantic taxa remain uncertain.

Polysiphonia delicatula Hollenberg 1968:62, Fig. IF.

TYPE LOCALITY: Pokai Bay, Oahu, Hawaii.

TYPE: US (D1911662).

DISTRIBUTION: Hawaiian Islands, Tuamotu Archipelago, Marshall Islands, Caroline Islands, Sargasso Sea.

SPECIMENS EXAMINED: Sargasso Sea: 28°N-70°W, 4.iii.1970, Volkmann (WJW 2423); 33°58'N-69°56.5'W, 15.v.1970, Woelkerling (WJW 2595); 37°N-70°W, 12.v.1970, Woelkerling (WJW 2631, 3229).

Female and tetrasporangial plants occurred as epiphytes on *Sargassum natans* and *Sargassum* sp.

Polysiphonia lanosa (L.) Tandy. Taylor 1957:341, pl. 56, Fig. 4, pl. 57, Figs. 14-15, pl. 59, Fig. 4. Woelkerling 1972:298.

Polysiphonia fastigiata auct. non. (Roth) Greville: Collins, Holden, and Setchell 1895:145; 1907:1444. Farlow 1881:175. Harvey 1853:54.

TYPE LOCALITY: unknown.

TYPE: LINN.

DISTRIBUTION: North Atlantic Ocean.

SPECIMENS EXAMINED: Sargasso Sea: 38°53'N-69°39'W, 10.v.1970, Woelkerling (WJW 2565).

Polysiphonia lanosa occurred as an epiphyte on *Asco-phyllum nodosum* (see Woelkerling, 1972) and is regarded as an invader.

Polysiphonia poko Hollenberg 1968:70, Figs. 3A, 15, 22.

TYPE LOCALITY: North Island, Pacific Ocean.

TYPE: US (H65-113.1).

DISTRIBUTION: tropical Pacific Islands (see Hollenberg), Sargasso Sea.

SPECIMENS EXAMINED: Sargasso Sea: 34°N-70°W, 10.i.1970, *Volk-mann* (WJW 2207); 37°30'N-70°W, 8.vii.1970, *Volkmann* (WJW 2703); 39°30'N-71°W, 6.x.1970, *Volkmann* (WJW 2858).

Female and tetrasporangial plants occurred as epiphytes on *Sargassum natans* and *Sargassum* sp.

SUMMARY

The epibiotic and pelagic algal flora of the western Sargasso Sea has been extended to include ten Chlorophyceae, 25 Phaeophyceae, and 33 Rhodophyceae. Nearly 75% of these taxa are newly reported for the Sargasso Sea. Pertinent references and taxonomic and ecological data are provided for each taxon, and indication is provided as to whether each species is likely to be a permanent component of the Sargasso Sea flora or merely a temporary invading element.

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